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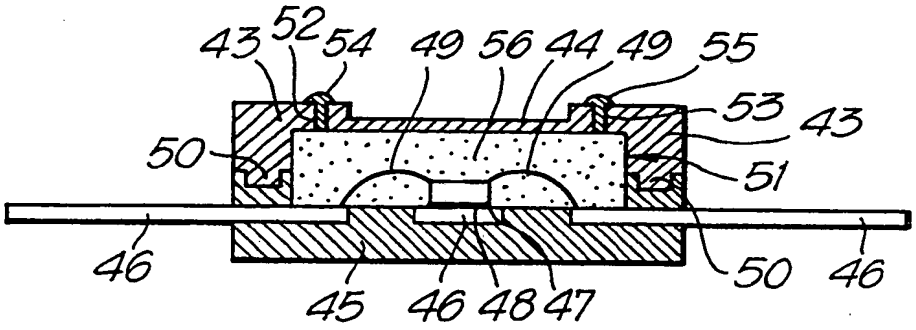


(57) Abstract

The invention relates to an arrangement for the encasing of a functional device, e.g., a semiconductor element, a semiconductor-based element, a sensor element, a microactuator, or an electronic circuit consisting of one or more integrated circuits and other electronic components, and a process for preparing an arrangement of this kind. Around the functional device (47) is arranged a casing (43, 45) which forms a closed cavity (51) which completely or partly surrounds the functional device (47). The casing is made of a plastic material or another polymer material. The casing consists of two or more joined components (43, 45). Metal parts which form wire bonds (46) with said functional device (47) in the casing pass through the walls of said casing. At least one of the casing pass through the walls of said casing. At least one of the casing components has filling holes or filling ducts (52, 53) for the introduction of liquid and/or gel material (56) into said cavity, and the filling holes or filling canals are sealed (54, 55) after the volume of the cavity has been filled with said liquid or gel.

ARRANGEMENT FOR ENCASING A FUNCTIONAL DEVICE, AND A PROCESS FOR THE PRODUCTION OF SAME

The present invention relates to an arrangement for encasing a functional device, wherein the casing forms at least one closed cavity which wholly or partly surrounds the functional device, wherein the casing is made of a plastic material, wherein metal conductors pass through the walls of the casing and form conductive connections to the encased said functional device, and wherein the cavity is sealed and filled with an electrically insulating fluid. Further, the invention comprises a process for the production of an arrangment of this kind, wherein the casing is formed by two or more components made of a plastic material which, when put together, form at least one cavity, wherein electrical conductors of metal are built into the casing, e.g., a leadframe which has a portion which projects outside the casing when the components are assembled, wherein the functional device is attached to the side of the cavity on one of the components prior to said components being secured to one another, wherein electrical terminals on the functioning body are attached to said respective conductors within the area of the cavity prior to said components being secured to one another, wherein the components are connected to one another in such a way that they are sealed, eg, by means of gluing or welding, wherein the electrically insulating fluid is inserted into the cavity through filling holes in an adjoining casing component, and wherein the filling holes are sealed closed so that the cavity is totally sealed.

In connection with the present invention, the functional device may, for instance, be a semiconductor element, a semiconductor-based element, a sensor element, a microactuator, or an electronic circuit comprising one or several integrated circuits and other electronic components.

The encasing of functional devices, e.g., semiconductor elements such as integrated circuits, is previously known. Normally this happens without the use of a cavity or hollow

only be used in the art of circuit boards.

EP Patent Publication 421005-A3 describes a casing of metal around an electronic device. A closed cavity is formed by means of two heat sink metal bodies, eg, plates, which are secured to one another by means of at least two separate sealing means. The leadframe is placed between the sealing means with connection to the electronic device. The assembly is complicated, time-consuming and also, therefore, expensive.

EP Patent Publication 216352-A3 discloses a device for compensating for mechanical tensions in solder bumps between thick-layer circuit boards which have a conductive pattern and an integrated circuit. This assembly is surrounded by a casing of metal or plastic which is in the form of a cup with a flat lid. A sealing material in the form of silicone gel is arranged over and around the assembly, whereupon either resin or air is disposed thereupon. Thereafter, the lid is fastened to the cup by means of a silicone adhesive of the reaction type. The silicone gel will penetrate in between the gap which exists between the integrated circuit and the circuit board, in addition to the fact that it will fill only a part of the cavity. The assembly process is demanding and is meant to solve only one specific problem in connection with solder bumps.

GB Patent Publication 2176936-A relates to a casing for a power semiconductor, wherein the casing consists of a heat-sink metal plate on which the power semiconductor is arranged via an electrically insulating plate, and an a hood which together with the metal plate forms a cavity, said cavity being sealed with a rigid resinous material which simultaneously supports and insulates the electrical conductors of the semiconductor. The cavity can, prior to being sealed, be filled with a gel substance, eg, gel resin. The hood may be made of metal, plastic or ceramics.

The fillers in a plastic material can be a source of alpha particles and can cause problems for integrated circuits of the memory kind. It is therefore common practice to protect the actual electronic chip with a thin layer of polyimide.

It is also common practice to use a number of tests in order to assess the reliablity of the components encased in plastic. A first type of test reveals problems with the actual chip, such as oxide defects and electro-migration. A second type of test can be a temperature test which may reveal, for instance, mechanical problems. A third test reveals, in the first place, chlorine-induced corrosion of bonding areas and aluminium wiring.

Today, approximately 85% of all integrated circuits are encased in plastic. There are, therefore, no fundamental reliability problems, and plastic encasing is carried out, as a rule, completely automatically and gives the possibility of great reliability for the individual casing. However, it is essential that the encased functional device is able to operate reliably under most field conditions, and not under the theoretical conditions which reign in a laboratory. The need for reliability must therefore be given top priority. In general, the encasing of a functional device shall provide protection against the surrounding environment, provide electrical connection from the functional device, e.g., an electronic chip, to the surrounding circuits, and provide a thermal coupling from the functional device to the surrounding environment. Here, no one factor is decisive. Usually special consideration has to be accorded to low wire capacitance and inductance, a sufficiently low level of mechanical tension in the materials, good material combatability, low thermal resistance, low leakage, high reliability, simple method of production, and low costs.

When using plastic in connection with a common plastic-moulded integrated circuit, the plastic will serve as a barrier against

materials have steadily been improved so that today there is a well developed system.

Thermosetting plastics are simple to moulded, and are stable in form during and after the actual moulding process. Novalac-based epoxy mixtures are used most often, optionally with a number of additives.

The use of silicone-based materials has also been known as the mechanical properties thereof are excellent and the temperature of use can be made higher, but the use of these materials has not gained much application because silicone traditionally bonds badly with other materials, for example, the metal in the leadframe. The use of silicone today is, in the main, restricted to putting a drop on top of integrated circuits as extra protection prior to moulding in epoxy. The prior art is also to dose silicone gel over integrated circuits prior to a lid optionally being put on in the different kinds of cavity casings.

Thermoplastics have undergone a great development and new materials are constantly being launched. Thermoplastics of this kind, more often than not, have excellent electrical and mechanical properties, and the temperature of use is often higher than that of epoxy materials. A further advantage with thermoplastics is a faster production time, lower moulding pressure, and possibilities for recycling the excess material. Thermoplastic materials have also enabled completely new design possibilities, such as snap-on solutions for mounting as well as possibilities of welded joints. However, its dimensional stability can be poorer than that of thermosetting plastics. There are also two difficult factors which mean that thermoplastics are usually not used for encasing wire-bonded integrated circuits, even though thermoplastics are used to a great extent in electrical systems in general, viz., thermoplastics have a high viscosity which can result in wire-scan, i.e., disturbances of the wire bonds in connection with

inductively, by ultra sonics, by means of lasers or friction welding by rubbing. Ultrasonic welding is the most suitable as the temperature can be controlled accurately whilst the welding area is well defined.

The composition of the plastic and the nature of the surface are of great significance for both welding and gluing.

A mechanical joining can be carried out by means of, for example, screwing, or for soft thermoplastics by means of, for example, snap-on connections.

A part of the complex of problems which is connected to the known solutions is aimed to be solved by means of the assembly and process in the present invention.

The known invention referred to by way of introduction is characterized according to the invention in that the casing is made of a thermoplastic, and that at least parts of the walls around the cavity are made so as to be compliant in order to be able to accommodate expansion forces from the said insulating fluid, or that a body in the form of a diaphragm or an elastomer is incorporated in the cavity in order to accommodate said expansion forces. The use of thermoplastic gives rise to simple and fast production, which in turn provides a reasonably priced, yet technically good product, as will also be made apparent in the specification hereinbelow. Further, the form of the walls around the cavity gives rise to the advantage that it easily compensates for changes in temperature which is essential in a casing of this kind.

According to an embodiment of the device, the cavity can be sealed by sealing one or several filling holes or filling ducts, after the volume of the cavity is filled with a liquid and/or a gel. The sealing can, in contrast to the known art, be carried out, for instance, by means of melting, thermal welding or friction welding of the material around the filling

a welding iron. As an alternative, the filling hole can be sealed by means of a sealing screw, a sealing bolt or a sealing ball, optionally in combination with an accompanying gasket.

It is essential that the mechanical properties of the casing are such that it has a strength which is sufficient that it cannot be damaged, nor that the functional device can be damaged during normal handling.

It will be expedient for the functional device to be soldered to the leadframe, if one is used, after the leadframe has been moulded in the plastic material. This requires that the plastic material is able to tolerate typical soldering temperatures, for example, 240° C to 280° C.

An alternative solution is that the functional device is soldered or alloyed to the leadframe and that a plastic casing is thereafter attached around the functional device. A further possibility is to use so-called epoxy die-attach which allows for the use of low temperatures. The material which fills the cavity in the casing will function as a water displacing insulation and corrosion protection, whilst the material serves to support the functional device in the cavity.

In order to be able to achieve the arrangement according to the invention, it is generally desirable to be able to use the said welding method in order to seal the casing, as this will give rational production and increase repeatability and reliability. The possibilities for snap-on connections between the parts which constitute the casing would increase assembly flexibility. This will mean that it is expedient to select a thermoplastic.

Still further embodiments of the arrangement and process according to the invention will be made apparent in the patent claims hereinbelow, as well as in the specification hereinbelow with reference to the enclosed diagrams.

invention, as it is defined in the patent claims hereinbelow.

Figure 1 illustrates a first embodiment of the process according to the invention.

Figure 2 illustrates a second embodiment of the process according to the invention.

Figure 3 illustrates different methods of sealing the cavity in a casing, according to the invention.

Figure 4 illustrates a first embodiment of the arrangement according to the invention.

Figure 5 illustrates a second embodiment of the arrangement according to the invention.

Figure 6 illustrates a third embodiment of the arrangement according to the invention.

Figure 7 illustrates a fourth embodiment of the arrangement according to the invention.

Figure 8 illustrates a fifth embodiment of the arrangement according to the invention.

Figure 9 illustrates a sixth embodiment of the arrangement according to the invention.

Figure 10 illustrates a seventh embodiment of the arrangement according to the invention, in combination with an integrated circuit.

Figure 11 illustrates an eighth embodiment of the arrangement according to the invention.

Figure 12 illustrates a ninth embodiment of the arrangement

alia, helped by ventilation through the ventilation hole 8, the holes 7 and 8 will be blocked, as is made apparent from fig. 1f. A blocking or sealing of this kind can take place by melting the material at the holes, or optionally by using sealing screws, sealing bolts or sealing balls. In certain cases, it may be desirable to use gasket in connection with these kinds of sealing means. The sealing means in fig. 1d are indicated by the reference numerals 11 and 12 for holes 7 and 8, respectively.

The metal parts 3 in fig. 1 are made of, for instance, a leadframe which is moulded in the component 6 prior to the components 5 and 6 being assembled.

In fig. 2, the functional device is also denoted by means of the reference numeral 1. The cavity which is to be formed is denoted by the reference numeral 13. The metal parts 14 can expediently be part of a metal frame and the functional device 1 is connected to the metal parts 14 via wire bonds 15 prior to the leadframe being attached to the lower component of the casing 17, shown in fig. 2. The leadframe 14 fits in terms of form to the lower component 17, as is made clear by the drawings. The upper component 16 of the casing is furnished with a filling hole 18 and a ventilation hole 19 for the filling material which is to fill the cavity 13. As in connection with fig. 1, the filling material can be a suitable liquid and/or gel. The leadframe is attached to the lower component 17 by means of glue 20, and the upper component 16 of the casing is connected to the leadframe 14 and the lower casing component 17 by means of glue 21, as said glues 20 and 21 will naturally function together. It would be expedient for glues 20 and 21 to be of exactly the same type. When the joining action, as illustrated in fig. 2c has been completed, a situation such as the one shown in fig. 2d occurs. Here, the cavity 13 is ready to be filled with a filling material, which in figs. 2e and 2f is designated by the reference numeral 22. After the filling material 22 has filled the cavity 13, said

filling material 30, the holes 35 and 37 are sealed by means of sealing screws, optionally with the use of gasket. Such screws may, of course, be self-threading.

A third alternative embodiment for sealing a cavity is illustrated in figs 3e and 3f. Here too, the reference numerals 25-30 and 1 denote the same elements as explained above in connection with figs 3a and 3 b, and 3c and 3d. In this case too, a filling hole 39 and a ventilation hole 40 have been made. After the cavity 29 has been filled with the filling material 30, the area around said holes 39 and 40 is melted to give an area indicated with reference numerals 41 and 42, respectively, wherein the material around the holes 39 and 40 has melted and flowed together to seal said holes 39 and 40. It has been proven in experiments, in spite of great prejudice from those with expertise in the field, that it is possible to melt closed the filling holes by means of applying heat locally and in the presence of a sealant, eg, silicone oil. Here, it would be expedient to use, for instance, a hot iron.

Figs. 3g and 3h show a variant of the solution in figs 3a and 3b. Instead of melting or welding the holes 31 and 32, it is proposed to seal said holes with respective sealing balls 31' and 32'.

The filling of the filling material, eg, liquid or a gel substance can be carried out by filling through the respective filling holes as shown and described in connection with figs 1-3, by making use of a vacuum. The cavity is subjected to a vacuum, whereupon the filling material will easily be sucked into the cavity. The different ways in which this vacuum suction can be carried out will be obvious for a person skilled in the art and does not require further explanation.

In this connection, mention ought to be made of the special conditions which are linked to pressure sensors. In relative

Figs 4-10 are to be described in more detail in order to illustrate a number of typical embodiment examples of the arrangement in the present invention, although these embodiment examples shall not be considered as being, per se, restrictive for the use of the invention.

In fig. 4, a first casing component 43 is shown, preferably made of thermoplastic. The component 43 has a compliant area 44 in the wall of the casing formed during the moulding of said component 43, or optionally formed during the moulding of the component 43 by moulding a compliant, thin metal plate into said component 43. During the moulding of a second casing component 45, a leadframe 46 is moulded therein and a functional device 47 can be attached to a part of the leadframe by means of a binding agent 48. Said functional device 47 forms connections with the electrical conductors 46 by means of wire bonds 49. The securing of said wires 49 to the conductors 46 takes place by means of known wire bonding art, per se.

When the two casing components 43 and 45 are brought together, a junction 50 is formed therebetween where, by means of welding or gluing a seal is formed between said two components 43 and 45.

When said two components 43 and 45 are brought together, there appears therebetween a cavity 51 which may be filled with a filling medium, eg, liquid or solid materials. One example of this is silicone gel. However, other kinds of filler are possible, eg. silicone oil. Holes 52 and 53 are provided to allow for the introduction of the filler 56 into the cavity 51. After the cavity has been filled with filler, said two holes 52 and 53 are sealed as is indicated by the reference numerals 54 and 55. This may take place by means of thermal sealing of the holes, ultrasonic welding, sealing screws, sealing bolts or sealing ball, optionally combined with gaskets. In this

The base 60 may be a coupling board with an electronic function, comprising active devices, functional devices 57, 58 and 59, for instance in the form of integrated circuits, and connecting systems (not visible on the drawing). The base or board can comprise a multilayer connecting system, and can, as mentioned, be an integral part of the second casing component 62. For the electrical connections 65, 66, 67, 68, 69, and 70, and for the sake of simplicity, no wire bonds with said base 60 are shown. However, it will be understood that such wire bonds will necessarily be present.

As is explained above, the two casing components 61 and 62 are brought together and thus a junction 75 is formed between the two components. This junction is sealed by welding or by gluing. Between said two components, a cavity 76 is formed which it is desirable to fill with a filling medium which is electrically insulating, e.g., a fluorocarbon. The filling medium 77 is introduced through hole 78 in the upper component 61 and ventilation takes place through hole 79 in the upper component. After cavity 76 has been filled with a filler, said holes 78 and 79 are sealed as is symbolized by reference numerals 80 and 81, and in accordance with one of the methods described hereinbefore.

Fig. 6 illustrates the invention in connection with the use of a circuit board as basis for constructing a cavity casing.

In this case too, there is a first casing component 83 and a second casing component 84 for the functional device 82. Said casing component 84 is, in effect, the circuit board to which the functional device 82 is to be bonded. In the upper casing component 83, a diaphragm may be moulded, e.g., made of metal or the same material, e.g., thermoplastic, as said first casing component 83. The diaphragm in fig. 6 is denoted by the reference numeral 85. In the lower casing component 84, which may be in the form of a circuit board, electrical wire bonds 86 are provided in the form of through-plated holes. These are

103 attached to a lower casing component 105. The upper casing component is indicated by the reference numeral 104. In said second or lower casing component 105 is arranged a number of contact pins 106, 107, 108 and 109, of which it will be seen that the contact pins 106 and 109 are connected with formed piece 97 via electrically conductive wire bonds 110 and 111. It will be understood immediately that the metallic conductors 107 and 108 form a corresponding connection with the piece 97 and the resistors 99 and 100 there. For reasons of practicality, these wire bonds are not shown.

The first or upper casing component 104 is equipped with a compliant diaphragm 112 which is an integral part of said first component 104, formed during the moulding thereof, or another compliant material which is mounted during the moulding of said component 104, or attached by means of gluing or any other known technique. When the two components 104 and 105 are brought together, a junction 113 is formed and is sealed by means of gluing or welding, e.g., ultrasonic welding. It is desirable to fill the cavity 114, which is formed between said two components 104 and 105 with diaphragm 112, with an electrically insulating filling material 114', expediently an electrical insulation liquid which fills the entire cavity 114. This occurs by providing horizontal holes 115 and 116 for the introduction of the filling material and ventilation, respectively. When said cavity 114 is full, the holes 115 and 116 are plugged as is symbolized by reference numerals 117 and 118.

This plugging can occur by any one of the methods described in connection with the preceding figures. The electrically insulating liquid has been denoted by the reference numeral 119. As will be apparent from fig. 7, the central opening 102 continues into the second casing cavity 105 in the form of a hole 120, so that, for instance, atmospheric pressure can lie against the lower side of the diaphragm 98. The embodiment in fig. 8 is, in effect, the same as in fig. 7 and with all the

is symbolized by the reference numerals 137 and 138. The method of sealing said holes 134 and 135 can be any one of those which have been shown and described in the preceding figures.

As will be made apparent from fig. 9, there is an electrically conductive wire bond 139 between the sensor element 125 and the electrical conductors 131 which conduct to the outside of the casing.

To be able to accommodate thermal expansion of the liquid 136 in the cavity 133, the first component 129 is equipped with a resilient area 140.

Fig. 10 illustrates, by means of a partly removed area, a large integrated circuit which shows how a multipin casing optionally could be formed. In this solution, a cavity 141 is provided, which may be filled with liquid or another filling material 141' through a hole 142 in the casing, and where ventilation may take place through an second hole 143.

Fig. 10a illustrates how, in a simple way, it is possible to achieve the invention, whilst fig. 10b shows partly in section the liquid-filled cavity 141, the upper casing component 144, and the integrated circuit 145 which is arranged in said cavity 141. The sealing of the filling hole and the ventilation hole are indicated by reference numerals 146 and 147.

In fig. 11, it is made apparent how the device according to the invention may be used where there is a need for a pressure gauge of the differential kind. The casing consists of a first component 148 and a second component 149 and an intermediate component 150. In the component 150, a lead frame 151 is moulded. A section 152 of the leadframe is opened and furnished with an open part 153 in said component 150. These open parts are closed by a differential pressure gauge 154 which is attached to the leadframe and has wire bonds 155 which

se. Thereafter, the top and base components are brought together, as is shown in fig. 12c, and are attached to one another by means of glue or welding, as is shown in fig. 12d. Electrically insulating fluid in the form of a liquid or a gel substance is then introduced into the cavity 177 thus formed via filling holes 178 and 179. The filling holes are sealed as previously described. As described for the preceding embodiments, it is expedient to allow one of the casing components to be equipped with a thinned part 180 which forms an expansion diaphragm.

After mounting, the hinge may optionally be cut away or it may serve as a mounting body for the casing.

Fig. 13 illustrates a variant of the previous embodiments wherein the casing contains two reciprocally physically separated cavities 181 and 182 which are formed by the base component 183 and the top component 184 of the casing. Electrical connections outside and inside the respective cavities occur via respective cast-in conductors 185 and 186, and wherein the connection from said conductors to the adjacent functional device is via respective wire members 187 and 188. In the solution shown here, there is also the possibility of joining the two cavities together by means of wire bond 191 and further to said functional device by means of wire members 192 and 193, respectively. The joining of the top and base components is carried out in the way which has been described previously. Filling the electrically insulating fluid 194 and 195 into cavities 181 and 182, respectively, occurs via filling hole 196 which may be sealed in any one of the previously described ways, eg, by means of a plug 197. In order to deal with possible expansion problems, the top component 184 is furnished with thin-walled parts 199 and 200.

Although the solution in fig. 13 is depicted with two cavities, it is within the limits of the taught art, of course, possible to form additional cavities by allowing the top component and

P A T E N T C L A I M S

1.
An arrangement for encasing a functional device (1; 47,51-60; 82; 87; 126-128; 145; 154; 175; 189,190), eg, a semiconductor element, a semiconductor-based element, a sensor element, a microactuator, or an electronic circuit consisting of one or more integrated circuits and other electronic components, wherein the casing forms at least one closed cavity (2; 13; 29; 51; 76-90; 114; 133; 141; 156,157; 177; 181,182) which either wholly or partly surrounds the functional device, wherein the casing is made of a plastic material, wherein metal parts (3; 14; 28; 46,64-71; 86; 106-109; 131; 151; 174; 185,186,191) pass through the walls of the casing and form wire bonds to the encased said functional device, and wherein the cavity is sealed and filled with electrically insulating fluid (10; 22; 30; 56; 77; 91; 114',136; 141'; 158; 181, 194, 195) characterized in that said plastic material is a thermoplastic, and that at least parts (44; 140; 170; 171; 180; 199,200) of the walls around the cavity are made compliant in order to be able to accommodate expansion forces from said electrically insulating fluid, or that in the cavity there is an inbuilt body (63; 85; 112) in the form of a diaphragm or an elastomer for the accommodation of said expansion forces.

2.
An arrangement according to claim 1, is
c h a r a t e r i z e d i n that the cavity is sealed by blocking one or more filling holes or ducts (7,8; 18,19; 31,32; 35,37; 39,40; 78,79; 93,94; 115,116; 134,135; 146,147; 160-163; 178,179; 196) after the volume of the cavity has been filled with a liquid and/or gel.

3.
An arrangement according to claim 1 or claim 2,

characterized in that at least part of the wall of the casing (170,171) is made so as to be resilient and is formed as a diaphragm, said diaphragm being constructed of the same material as the casing, or the diaphragm (112) being constructed in another elastic material and being inserted during a moulding process, a welding process or a gluing process, that the cavity, or cavities, (114; 156; 157) is filled with an electrically insulating liquid (114; 158,159), that the internal functional device (97; 154) contains a pressure-sensitive member which converts pressure signal(s) into electric signal(s), e.g., by said member being piezo-resistant, and that said diaphragm is so elastic that it can transfer pressure from an external pressure medium to said internal liquid and thus to the functional device.

8.

An arrangement according to one or more of claims 1 to 7, characterized in that the functional device contains an acceleration-sensitive member which can convert positive or negative acceleration into an electric signal, e.g., a member consisting of a mass-spring system (125-128) formed with one or more silicon springs (126) with integrated piezo-resistant resistors (128) and a seismic mass (127) arranged around the spring or springs and which gives rise to the springs bending because of the inertia of the mass against said acceleration.

9.

An arrangement according to one or more of claims 1 to 5, characterized in that one part of the wall of the casing is made so as to be compliant and is formed as a diaphragm (112) wherein said diaphragm is of the same material as the casing, or is of another elastic material, flush-mounted, for instance, during a moulding process, a welding process or a gluing process, that the cavity (114) is filled with an electrically insulating liquid (114'), that the internal functional device contains a pressure-sensitive member

to the pressure in the internal liquid relative to the pressure which the mass of the liquid or gel in said cavities cause when it is subjected to pressure or the effect of another force.

12.
An arrangement according to one or more of the preceding claims, c h a r a c t e r i z e d i n that the casing consists of two (5,6; 16,17; 25,26; 43,45; 61,62; 83,84; 104,105; 129,130; 171,172; 183,184) or more (148,149,150) components which may be joined together.

13.
An arrangement according to claim 12,
c h a r a c t e r i z e d i n that said joinable components (171,172) are moulded as one single piece, the adjacent components being joined to one another by means of a hinge member (173) made of the same plastic material as said two components.

14.
An arrangement according to claim 12 or claim 13,
c h a r a c t e r i z e d i n that the number of cavities in the casing is N - 1, or N + n, where N is the number of joinable components of which the casing consists and n = 1, 2, 3, 4....., etc.

15.
An arrangement according to claim 14,
c h a r a c t e r i z e d i n that the number of cavities is two or more, wherein there is an electrical connection (191) between said cavities.

16.
An arrangement according to claim 14,
c h a r a c t e r i z e d i n that said electrical connection (191) is formed in the component (183) of the casing in which the other electrical connections (185,186) to the

made of a thermoplastic material, and that at least parts (44; 140; 170; 171; 180; 199,200) of the walls around the cavity are made so as to be resilient for the accommodation of expansion forces from said electrically insulating fluid, or in that a body (63; 85; 112) is built into the cavity in the form of a diaphragm or an elastomer for the accommodation of said expansion forces.

19.
A process according to claim 18,
c h a r a c t e r i z e d i n that the filling holes are sealed by means of thermal welding or friction welding (figs. 3a,3b; figs 3e,3f).

20.
A process acording to claim 19,
c h a r a c t e r i z e d i n that said thermal welding takes place by means of the local application of heat around said filling holes, e.g., by means of a welding iron.

21.
A process according to claim 18,
c h a r a c t e r i z e d i n that said filling hole is sealed by means of sealing screw or screws, sealing bolt or bolts (figs 3c, 3d) or sealing ball or balls (figs 3g, 3h), optionally in combination with accompanying gasket.

22.
A process according to claim 17,
c h a r a c t e r i z e d i n that the joinable components of the casing are press moulded in a single piece and in such a way that a bendable hinge is formed between the adjacent moulded components.

Fig. 2a.

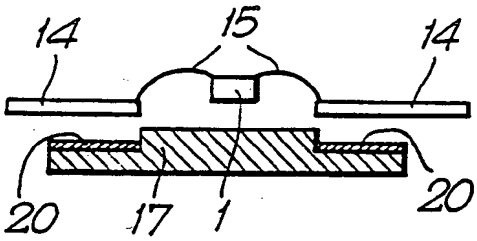


Fig. 2b.

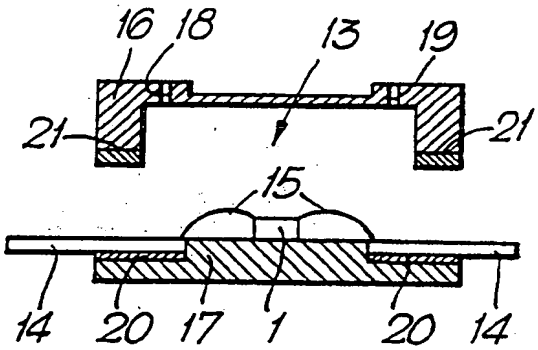


Fig. 2c.

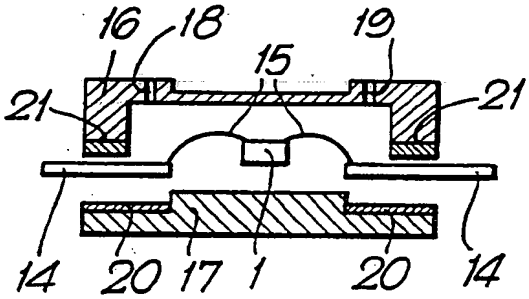


Fig. 2d.

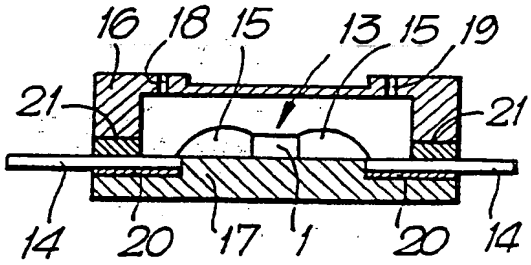


Fig. 2e.

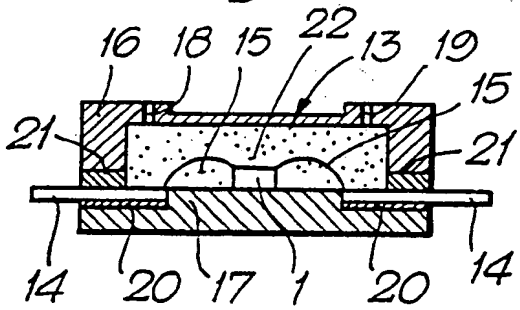


Fig. 2f.

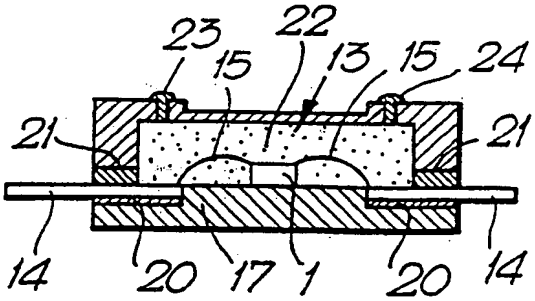


Fig. 3g.

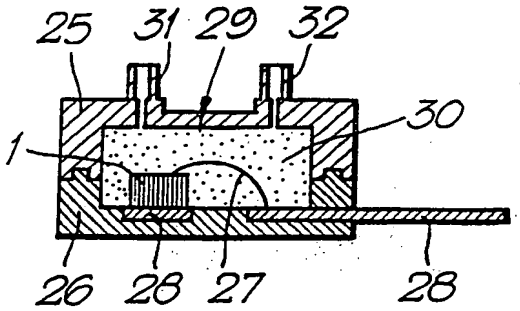


Fig. 3h.

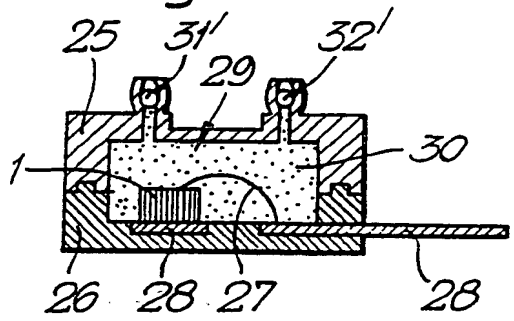


Fig. 4.

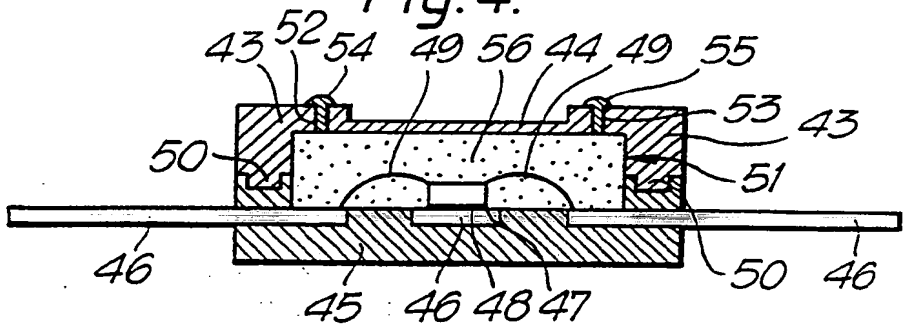
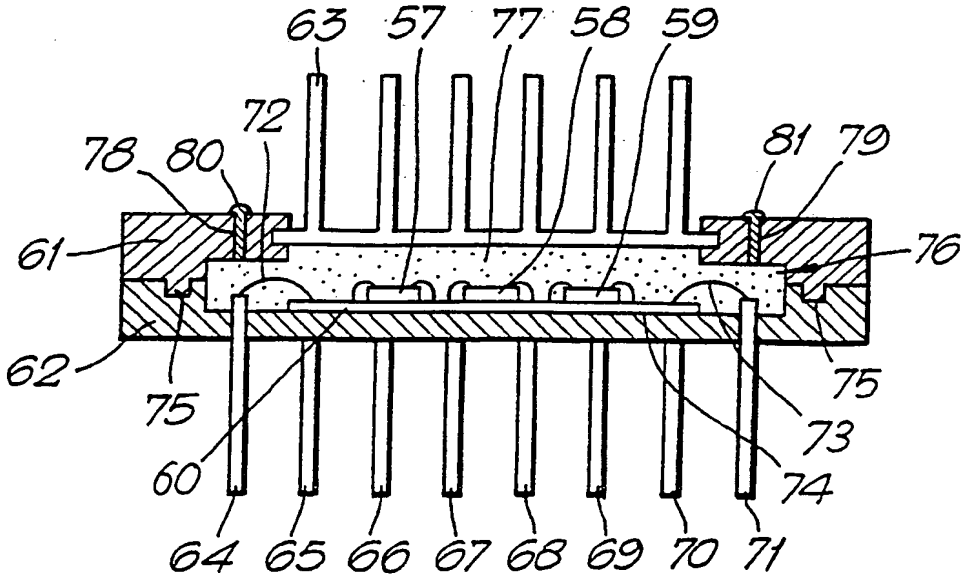


Fig. 5.



SUBSTITUTE SHEET

Fig.8.

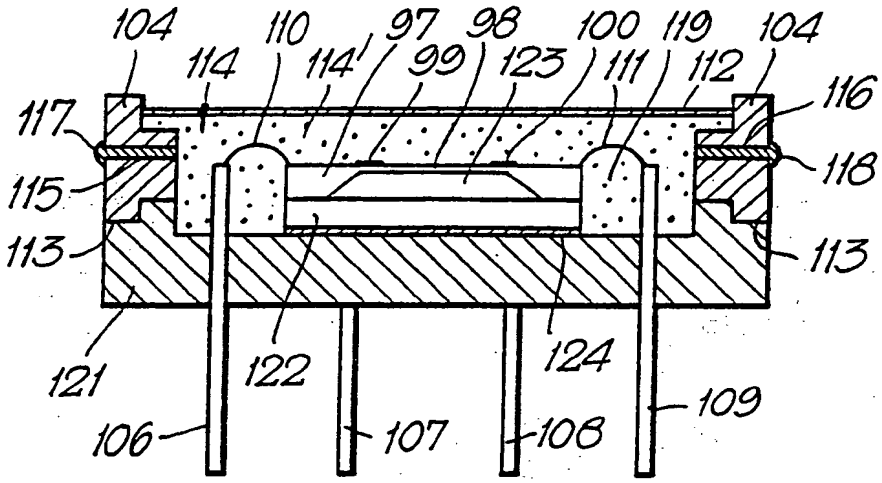


Fig.9.

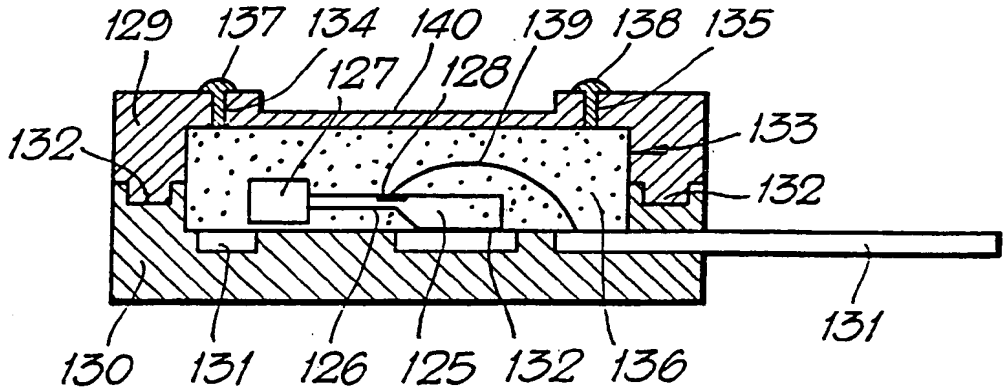


Fig.11a.

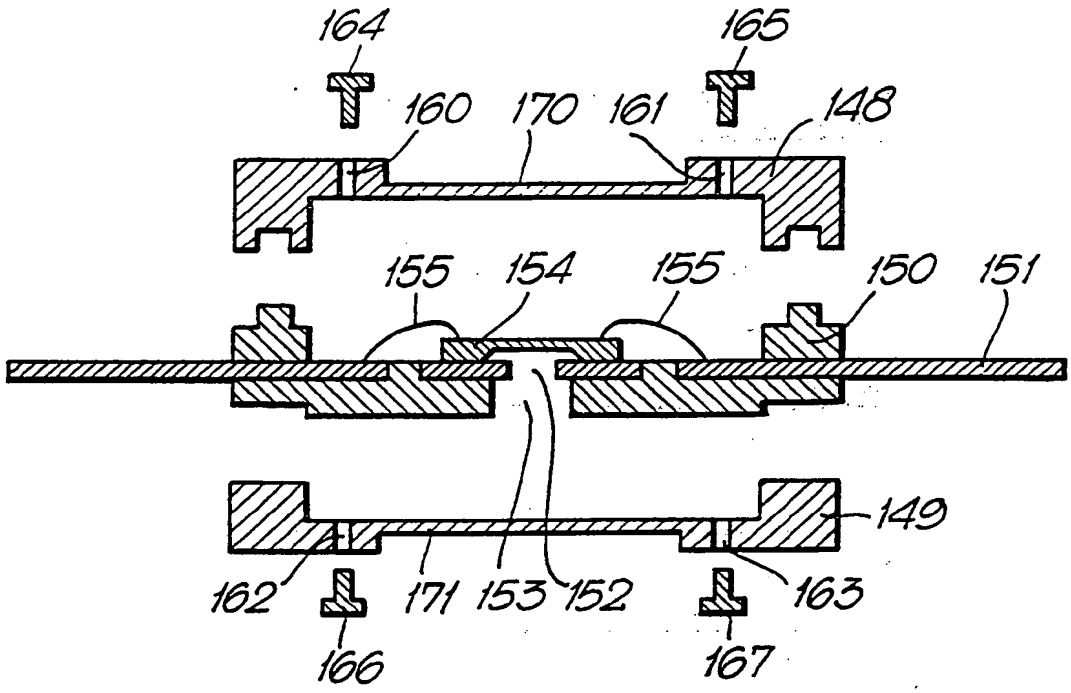
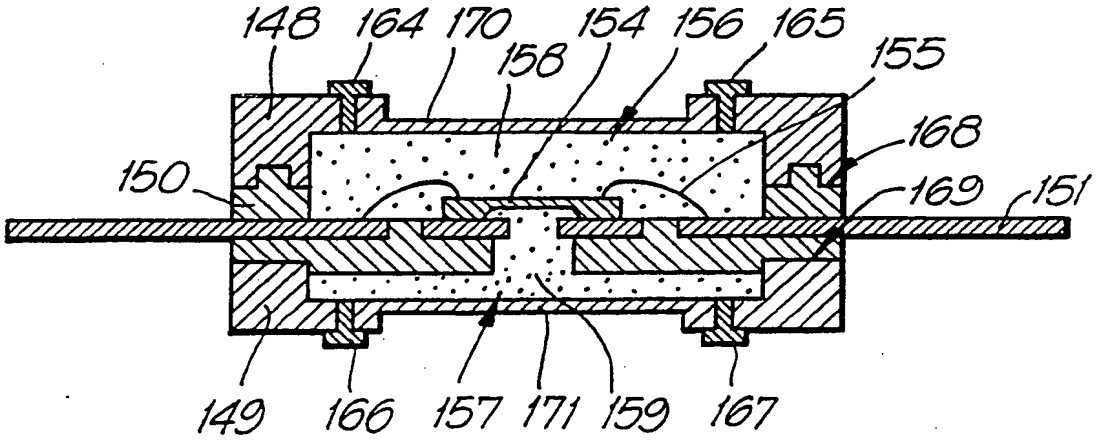


Fig.11b.



INTERNATIONAL SEARCH REPORT

International Application No PCT/NO 92/00085

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: H 01 L 23/02, 23/16, 21/54

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	H 01 L

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
A	US, A, 4961106 (S.H. BUTT ET AL) 2 October 1990, see column 7, line 6 - column 8, line 46; figures 13,14 --	1-21
A	US, A, 4801998 (H. OKUAKI) 31 January 1989, see the whole document --	1-21
A	EP, A2, 0421005 (OLIN CORPORATION) 10 April 1991, see column 8, line 13 - column 9, line 14; figure 4 --	1-21
A	EP, A2, 0216352 (NIPPONDENSO CO., LTD) 1 April 1987, see column 2, line 8 - column 4, line 9; figure 1 --	1-21

* Special categories of cited documents: [10]

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
20th August 1992	1992 -08- 21
International Searching Authority	**Signature of Authorized Officer**
SWEDISH PATENT OFFICE	Stig Edhborg

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.PCT/NO 92/00085

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on 01/07/92
The Swedish Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		WO-A- 88/07761	88-10-06
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		US-A- 5013871	91-05-07
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